

Analysis of the Causes of Hypoglycemic Reactions in Patients with Diabetic Nephropathy during the Peri-dialysis Period

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Abstract: *Objective:* To provide clinical evidence for controlling the incidence of hypoglycemia in patients with diabetic nephropathy during the peri-dialysis period by analyzing the causes of hypoglycemic reactions in diabetic patients during this period in our hospital. *Methods:* A total of 56 patients with diabetic nephropathy in the peri-dialysis period (i.e., glomerular filtration rate eGFR < 15ml/(min*1.73 m²) up to three months after dialysis) who received outpatient, inpatient, and hemodialysis treatments in our hospital from June 2022 to December 2023 were selected as the research subjects. The occurrence of hypoglycemia in the non-dialysis period and the initial dialysis period of the patients was collected (hypoglycemia was judged according to Whipple's triad: a. Clinical manifestations: symptoms such as palpitation, sweating, blurred vision, dizziness, etc.; b. Blood glucose index ≤ 3.9 mmol/L; c. Hypoglycemic symptoms were relieved after sugar supply or food supplementation). The nutritional status, diabetes duration, fasting blood glucose (FBG), random blood glucose (RBC), glycated albumin (GA), glycated hemoglobin (HbA1c), blood cell analysis, renal function, regular diet, body mass index (BMI), oral hypoglycemic drugs, and injection hypoglycemic drugs of the patients with hypoglycemia were monitored. The influencing factors of hypoglycemia in the non-dialysis stage and the initial dialysis stage were analyzed respectively. *Results:* The incidence of hypoglycemia in patients in the non-dialysis stage was 5.3%, and that in the initial dialysis stage was 21%. The incidence of hypoglycemia in these two stages was negatively correlated with nutritional status, regular diet, fasting blood glucose (FBG), random blood glucose (RBC), glycated albumin (GA), glycated hemoglobin (HbA1c), and the dosage of hypoglycemic drugs, and was positively correlated with anemia and albumin (ALB). Among them, in the initial dialysis stage, glycated albumin (GA), random blood glucose (RBC), anemia, the dosage of injection hypoglycemic drugs, and the eating situation on the day of dialysis could predict the occurrence of hypoglycemic reactions. *Conclusion:* The incidence of hypoglycemic reactions in the initial dialysis stage was significantly higher than that in the non-dialysis stage, especially the hypoglycemia that occurred during the dialysis process seriously affected the dialysis effect of patients. Therefore, by improving the nutritional status of patients, regular diet, improving anemia, monitoring random blood glucose (RBC), glycated albumin (GA), and timely adjusting the dosage of hypoglycemic drugs, the occurrence of hypoglycemic reactions in patients with diabetic nephropathy during the peri-

dialysis period can be minimized.

Keywords: Diabetic nephropathy; Peri-dialysis period; Hypoglycemia

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1. Introduction

In China, diabetic nephropathy accounts for 20%–40% of all diabetic patients^[1–2]. Affected by metabolism and along with the disease evolution process, the proportion of patients who need hemodialysis replacement therapy when they progress to stage 5 of chronic kidney disease also increases. Its complications have become more risk factors threatening the life and health of patients. Hypoglycemia, as the most common complication of diabetes, has a particularly prominent incidence in patients during the peri-dialysis period, seriously affecting the prognosis of the disease. Without timely intervention, it can even directly lead to loss of consciousness or death of patients. This study intends to analyze the causes of hypoglycemia in patients during the peri-dialysis period and provide clinical evidence for reducing the incidence of hypoglycemia in patients with diabetic nephropathy during the peri-dialysis period. The details are as follows.

2. Data and methods

2.1. Research subjects

A total of 56 patients with diabetic nephropathy in the peri-dialysis period (i.e., with a glomerular filtration rate $eGFR < 15\text{ml}/(\text{min} \cdot 1.73\text{m}^2)$ up to three months after dialysis) who received outpatient, inpatient, and hemodialysis treatments in our hospital from June 2022 to December 2023 were selected as the research subjects. The patients were aged between 18 and 75 years old, had no infections, surgeries, or traumas in the past month, and had no primary or secondary dementia, schizophrenia, intellectual disabilities, consciousness disorders, or ketoacidosis. All patients received treatments such as hypoglycemic therapy, correction of anemia, and regulation of calcium-phosphorus metabolism disorder as prescribed by doctors. The study was reviewed and approved by the hospital ethics committee. The patients and their families were fully informed of the study content and signed the informed consent form.

2.2. Research methods

The peri-dialysis period of the patients was divided into the non-dialysis stage and the initial dialysis stage. The occurrence of hypoglycemic reactions in these two stages was collected respectively. The nutritional status, diabetes duration, fasting blood glucose (FBG), random blood glucose (RBC), glycated albumin (GA), glycated hemoglobin (HbA1c), blood cell analysis, renal function, regular diet, body mass index (BMI), oral hypoglycemic drugs, and injection hypoglycemic drugs of the patients with hypoglycemia were monitored.

2.3. Evaluation methods

Hypoglycemia was judged according to Whipple's triad: a. Clinical manifestations: symptoms such as palpitation, sweating, blurred vision, dizziness, etc.; b. Blood glucose index $\leq 3.9\text{ mmol/L}$; c. Hypoglycemic symptoms were relieved after sugar supply or food supplementation. (2. Observation and Nursing of Hypoglycemic Reactions in

2.4. Statistical processing

In this study, SPSS18.0 statistical software was used to analyze the results. The statistical method adopted was the chi-square (χ^2) test. The significance level of the test was set at $\alpha = 0.05$, and a p-value < 0.05 was considered statistically significant.

3. Results

The incidence of hypoglycemia in patients in the non-dialysis stage was 5.3%, and that in the initial dialysis stage was 21%. The incidence of hypoglycemia in these two stages was negatively correlated with nutritional status, regular diet, fasting blood glucose (FBG), random blood glucose (RBC), glycated albumin (GA), glycated hemoglobin (HbA1c), and the dosage of hypoglycemic drugs, and was positively correlated with anemia. Among them, in the initial dialysis stage, glycated albumin (GA), random blood glucose (RBC), anemia, the dosage of injection hypoglycemic drugs, and the eating situation on the day of dialysis were closely related to the occurrence of hypoglycemic reactions.

4. Discussion

In recent years, the number of diabetic patients with concurrent nephropathy who need hemodialysis replacement therapy has been increasing year by year. Insulin in the human body is metabolized through the liver and kidneys. However, due to kidney damage caused by diabetes, the inactivation of insulin in the body is reduced, which easily leads to the accumulation of insulin in the body and ultimately affects the blood glucose level of patients ^[3]. This study showed that more than half of the patients with renal failure in the non-dialysis stage complained of digestive tract symptoms such as loss of appetite, aversion to greasy food, and frequent nausea before starting hemodialysis treatment. Laboratory tests showed that glycated albumin (GA), random blood glucose (RBC), glycated hemoglobin (Hb), red blood cells (RBC), and albumin (ALB) were all lower than the normal values, while serum creatinine (SCr) and blood urea nitrogen (BUN) were abnormally high, and the glomerular filtration rate eGFR was less than 15ml/(min*1.73 m²). Therefore, the gastrointestinal reactions caused by renal failure, which directly affect the insufficient nutritional intake of patients, are the leading factors. In addition, various complications such as emotional instability and anemia caused by nephropathy itself affect the daily lifestyle of patients, resulting in untimely blood glucose monitoring and adjustment of hypoglycemic drugs. The co-existence of these factors can lead to hypoglycemia in some patients.

Some studies have confirmed that when hemodialysis is performed with sugar-free dialysate, the glucose loss is approximately 5.5 grams per hour, and hypoglycemic reactions are prone to occur 2 hours before dialysis (consistent with the results of this study). This study showed that most of the diabetic nephropathy patients in the initial dialysis stage had hypoglycemic reactions during the induction dialysis stage. 35% of the patients had concurrent hypotension when hypoglycemic reactions occurred. The incidence of hypoglycemia in patients using short-acting hypoglycemic drugs was 10.5% higher than that in patients using long-acting hypoglycemic drugs. Fasting blood glucose (FBG), random blood glucose (RBC), glycated albumin (GA), and glycated hemoglobin (HbA1c) were all at a normal but relatively low level. During the induction dialysis stage, the clearance rates of serum creatinine (SCr) and blood urea nitrogen (BUN) decreased, but the previous accompanying digestive tract

symptoms had not been significantly relieved, and patients still did not have a regular diet. The combined effect of these two factors led to a higher incidence of hypoglycemia in patients. The higher incidence of asymptomatic hypoglycemia in the initial dialysis stage of patients was consistent with the research of Wei Jun et al., that is, when patients had symptoms such as palpitation, sweating, blurred vision, and dizziness during dialysis, the measured blood glucose was ≤ 3.5 mmol/L.

The incidence of hypoglycemic reactions in diabetic nephropathy patients is relatively high when the glomerular filtration rate is less than $15\text{ml}/(\text{min}\cdot 1.73\text{ m}^2)$. A severe hypoglycemic reaction or a cardiovascular event triggered by it may offset the benefits of maintaining normal blood glucose before, and even threaten life ^[4]. This study found that monitoring patients' fasting blood glucose (FBG), random blood glucose (RBC), and glycated albumin (GA) can partially predict the probability of patients having hypoglycemia. Adjusting the usage time and dosage of hypoglycemic drugs in a timely manner according to the patients' diet or correcting patients' malnutrition can prevent the occurrence of hypoglycemic reactions in the initial dialysis stage. Due to the varying degrees of edema in some patients, the body mass index has a relatively small impact on the incidence of hypoglycemia. Strengthening inspections during hemodialysis, providing targeted education, and improving patients' self-management level can reduce or avoid the occurrence of hypoglycemia ^[5]. Due to factors such as single-center and short-time span, this study only made a preliminary exploration. How to reduce the hypoglycemic reactions in peri-dialysis patients still needs further exploration by scholars.

Disclosure statement

The authors declare no conflict of interest.

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